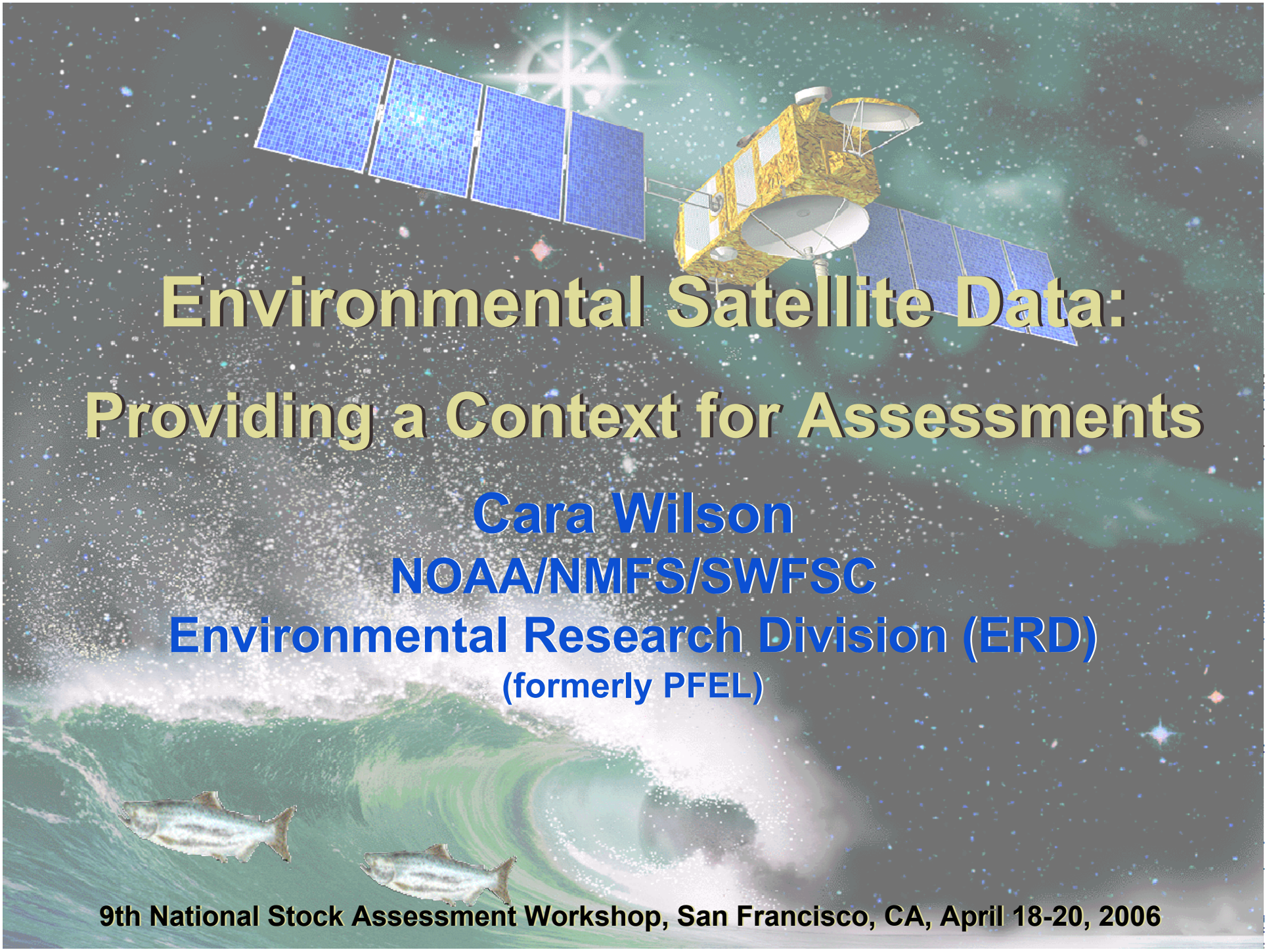


Environmental Satellite Data:

Providing a Context for Assessments

Cara Wilson

NOAA/NMFS/SWFSC

Environmental Research Division (ERD)

(formerly PFEL)

9th National Stock Assessment Workshop, San Francisco, CA, April 18-20, 2006

NMFS-Satellite group

- Satellite POCs for each science center (appointed by lab director)

AFSC	Jeff Napp (Seattle)
NEFSC	Jay O'Reilly (Narragansett)
NWFSC	Bill Peterson (Newport)
PIFSC	Jeff Polovina (Honolulu)
SEFSC	Tom Leming (Mississippi)
SWFSC	Cara Wilson (Pacific Grove)
ST	Kenric Osgood (Silver Spring)

POC also a CoastWatch PI

Labs outside of the regional HQ laboratory

Contributors

Jay Barlow	NOAA/NMFS/SWFSC
E.A. Becker	UCSB
Steven Berkeley	UC Santa Cruz
Bob Brownell	NOAA/NMFS/SWFSC
Rich Charter	NOAA/NMFS/SWFSC
Rich Cosgrove	NOAA/NMFS/SWFSC
Dave Foley	NOAA CoastWatch, West Coast node
Karen Forney	NOAA/NMFS/SWFSC
M.C. Ferguson	NOAA/NMFS/SWFSC
Jefferson Hinke	NOAA/NMFS/SWFSC
Trevor Platt	Bedford Institute of Oceanography
Xuemei Qiu	NOAA/NMFS/SWFSC ERD
Jessica Redfern	NOAA/NMFS/SWFSC
R.C. Smith	UCSB
Vera Trainer	NOAA/NMFS/NWFSC
George Watters	NOAA/NMFS/SWFSC
Jay Zwally	NASA/GSFC

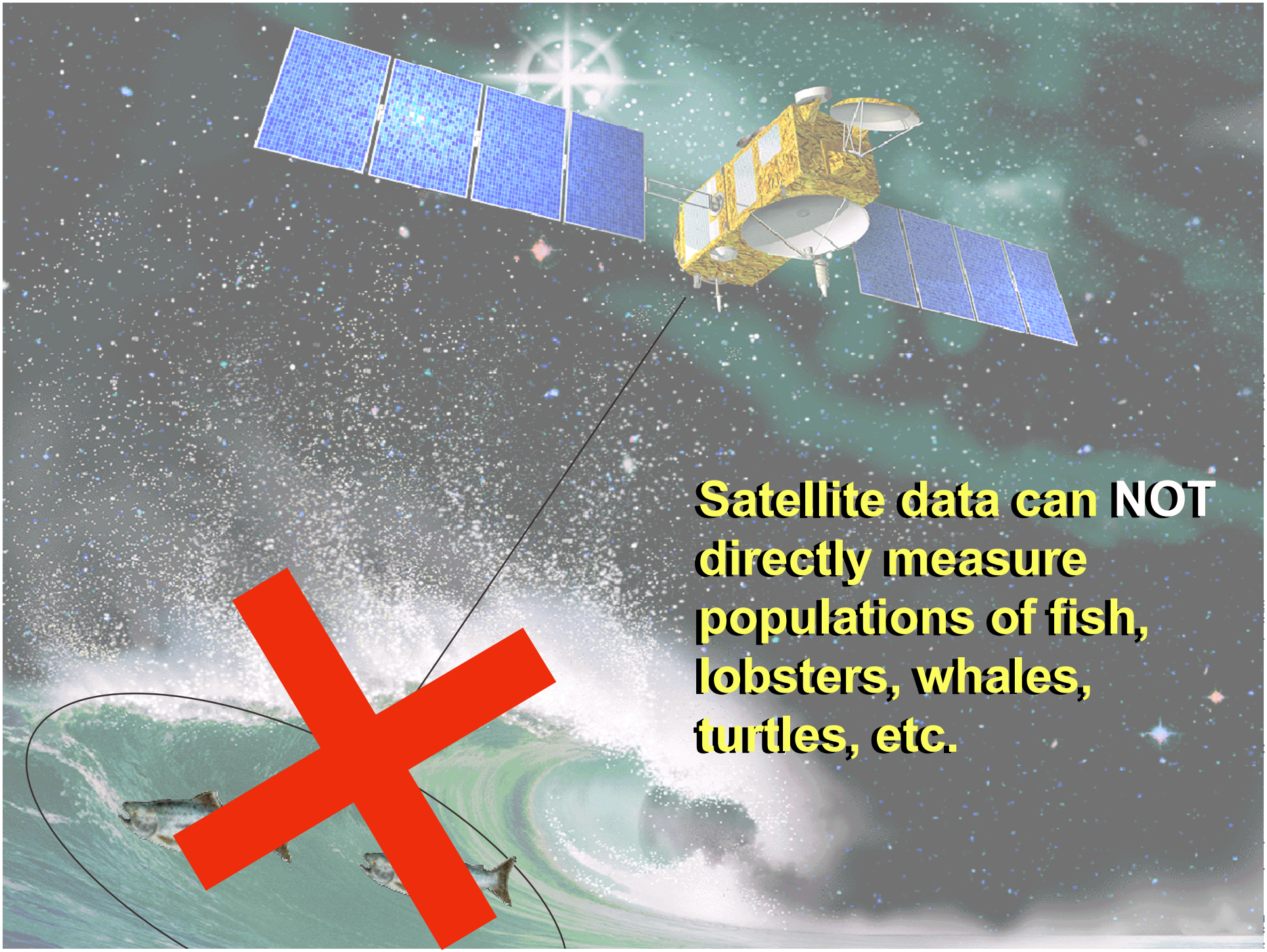
Acknowledgments

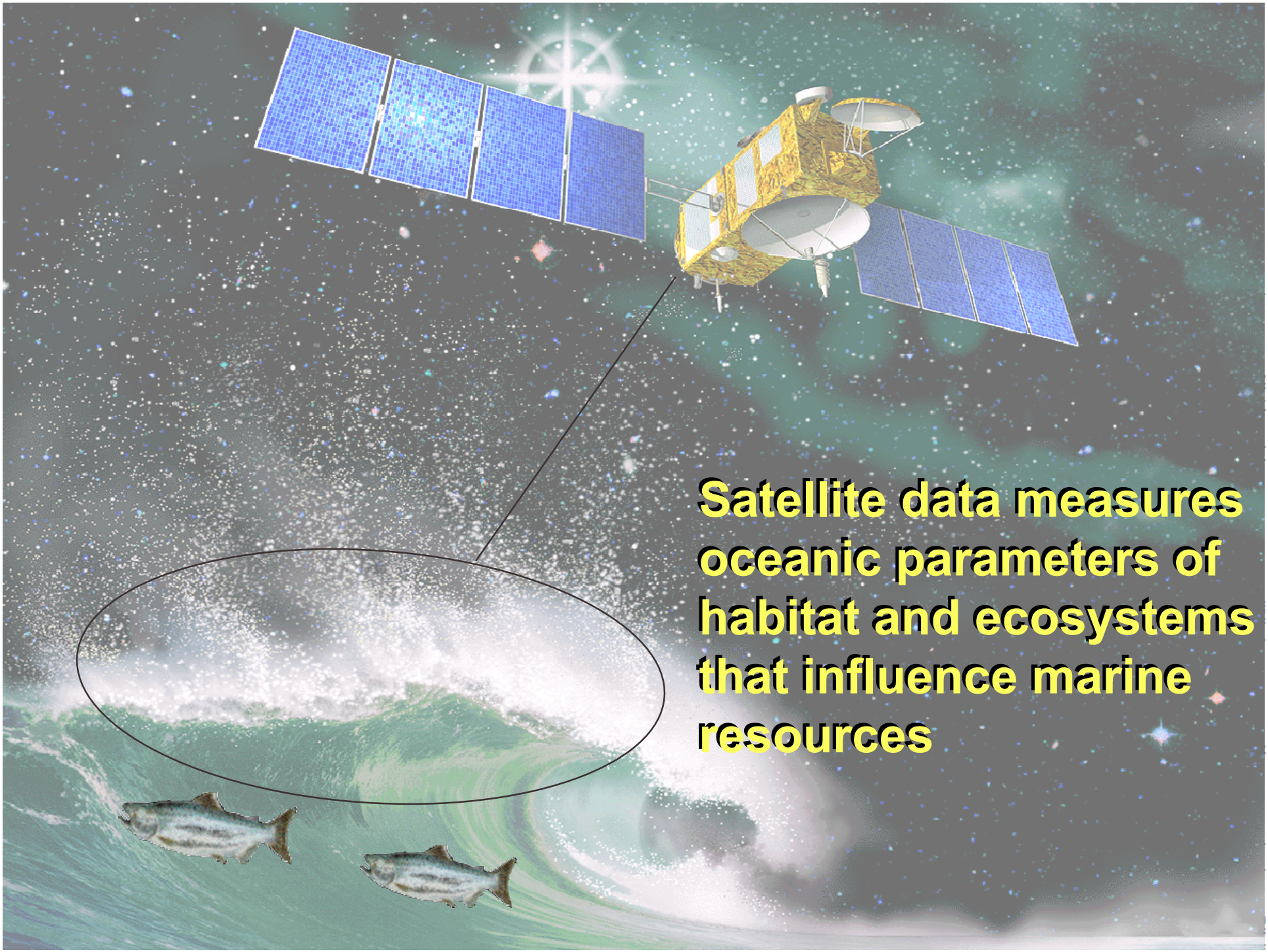
Special thanks to

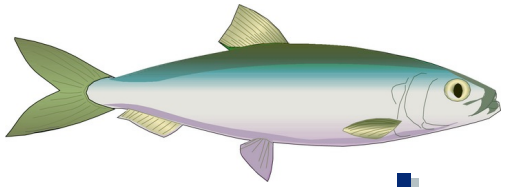
Stan Wilson and John Pereira (NESDIS)

and

NOAA's Satellite Research & Operations (R&O) transition project


Satellite data can NOT directly measure populations of fish, lobsters, whales, turtles, etc.

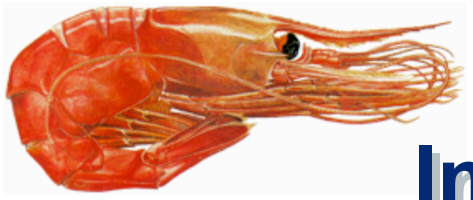

Satellite data measures oceanic parameters of habitat and ecosystems that influence marine resources



Ocean Features Important to Ecosystems

- Ocean ‘fronts’, boundaries, ‘edges’
- River plumes
- Coastal regions
- Mesoscale circulation patterns: eddies, meanders, ‘loops’
- Convergence zones
- Subsurface thermal structure: MLD, thermocline
- Ocean surface winds
- Ocean currents
- Wave heights

Most of these ocean features can not be adequately resolved without satellite data



Temporal Events Important to Ecosystems

- Upwelling
- Harmful Algae Blooms (HABs)
- Oil Spills
- Seasonal Transitions
- El Niño events
- Regime Shifts (i.e. PDO)
- Global Climate Change

Climate change can affect the timing and/or intensity of many of these processes

Climate Data Records (CDRs) of satellite measurements need to be maintained!

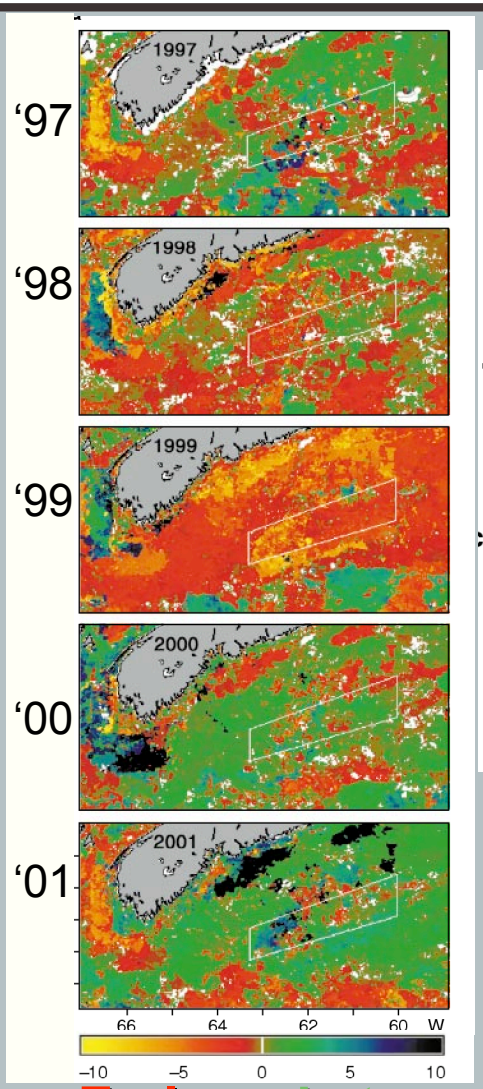

Some Satellite Applications
Relevant to Stock Assessment

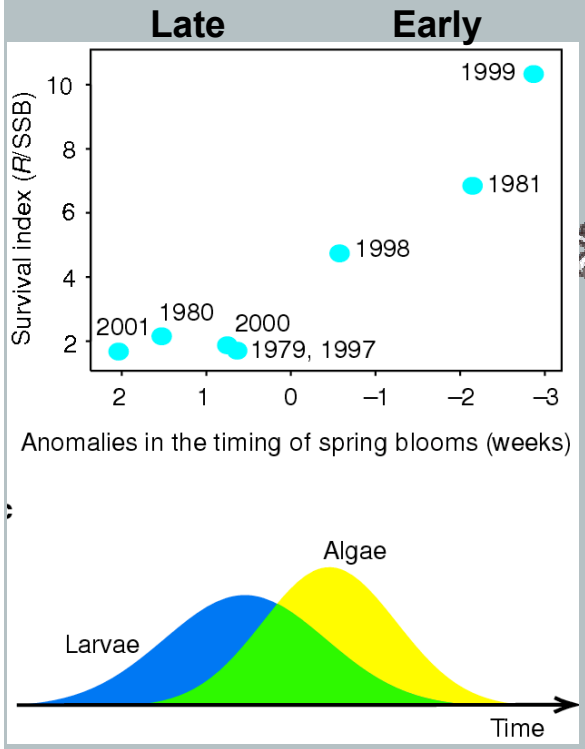
Timing of the Spring bloom and Haddock Survival

(Melanogrammus aeglefinus)

Test of the match-mismatch hypothesis

Annual anomaly in the timing of the spring bloom based on SeaWiFS chlorophyll data

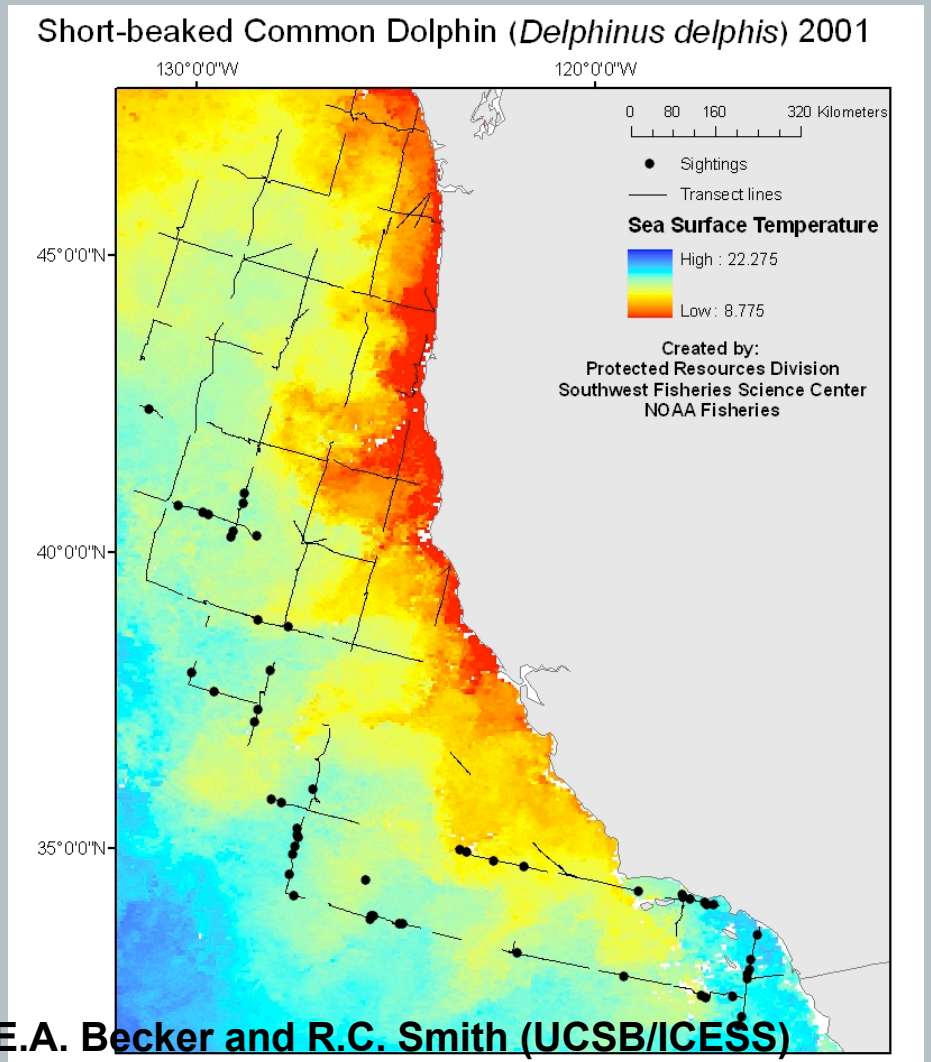




Earlier bloom means more time in the 'green' zone

From Platt et al., Nature, 2003

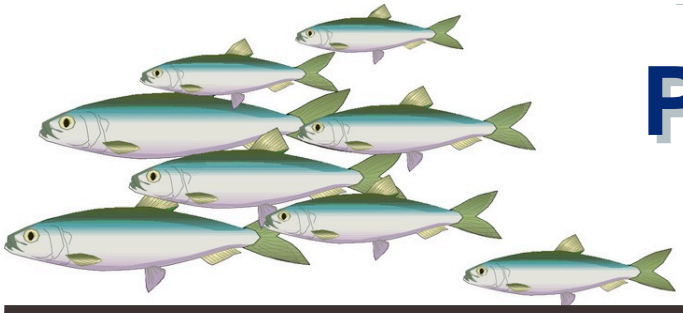
Modeling Cetacean Distribution



Pathfinder SST data

- Easily acquired in GIS-ready format
- Adequately resolves key features of CCS

E.A. Becker and R.C. Smith (UCSB/ICESS)
K.A. Forney, J.V. Redfern, M.C. Ferguson, J. Barlow, R. Cosgrove (NOAA/NMFS/SWFSC)



Population Analysis of Minke Whales

- **Abundance estimate for Antarctic Minke whales decreased from 730,000 in CPII to 360,000 in CPIII - *Why??***
- **Changes in sea-ice distribution has been put forth as a potentially important factor.**
- **Satellite sea-ice data is being examined to test this hypothesis.**

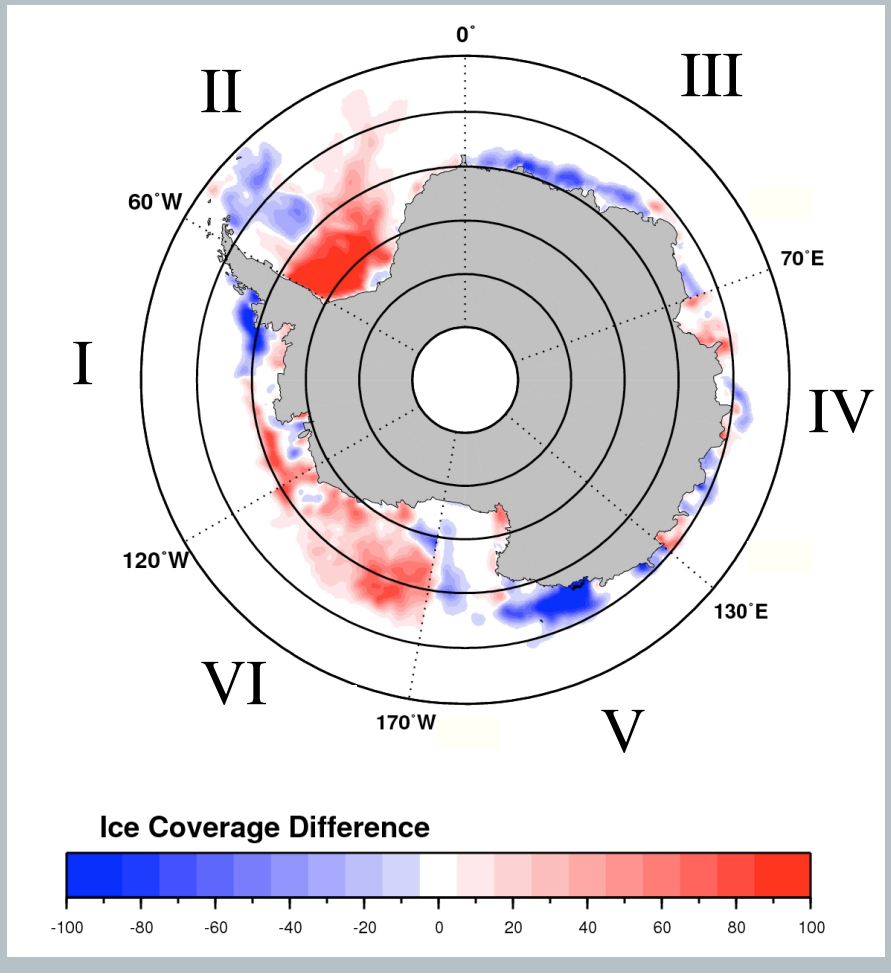
Work in progress by Brownell & Wilson, NOAA/NMFS/SWFSC ERD

Population Analysis

(Balaenoptera bonaerensis)

Sea Ice data provided by Jay Zwally, NASA/GSFC
Data analysis by Xuemei Qiu, NMFS/SWFSC

More ice in CP-III
Less ice in CP-III

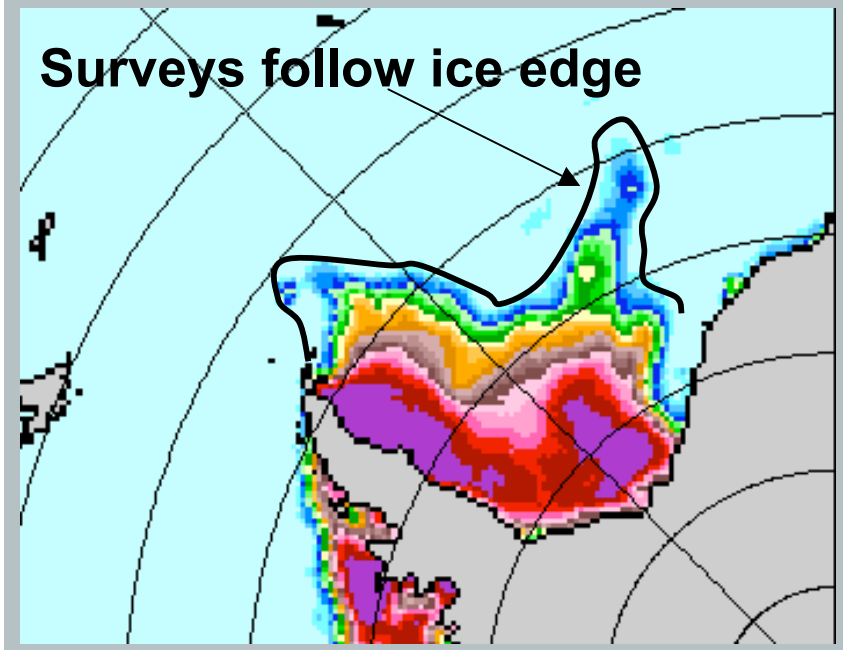


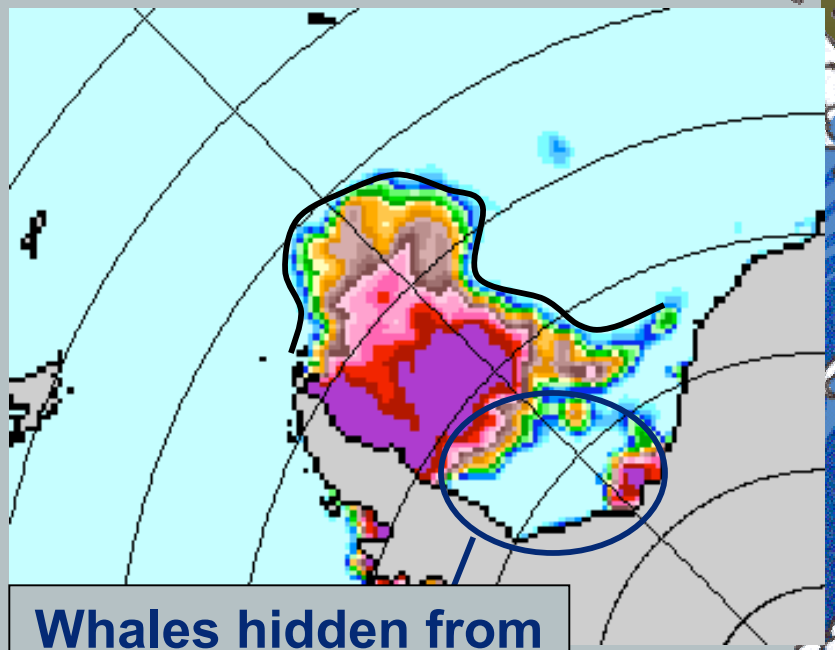
Population Analysis

(Balaenoptera bonaerensis)

Jan 1987, CP-II
141,000 Minke whales

Jan 1998, CP-III
35,000 Minke whales





Whales hidden from survey in polynya?

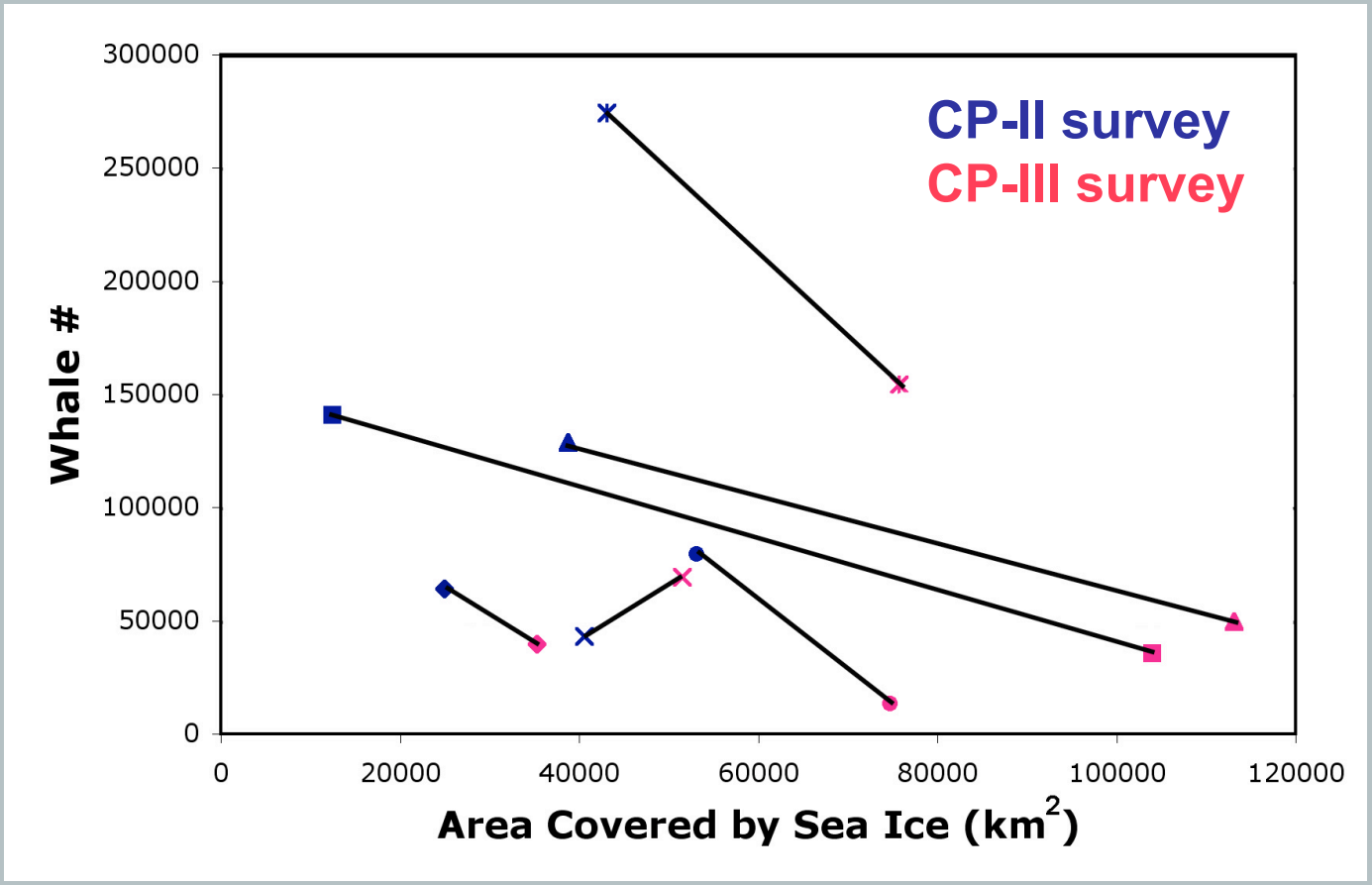
Sea Ice data provided by Jay Zwally, NASA/GSFC

Work in progress by Brownell & Wilson, NOAA/NMFS/SWFSC ERD

Population Analysis

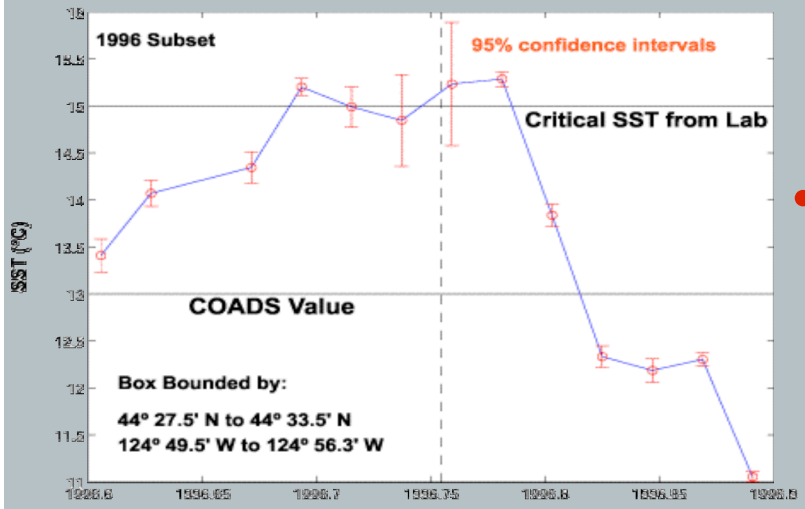
(Balaenoptera bonaerensis)

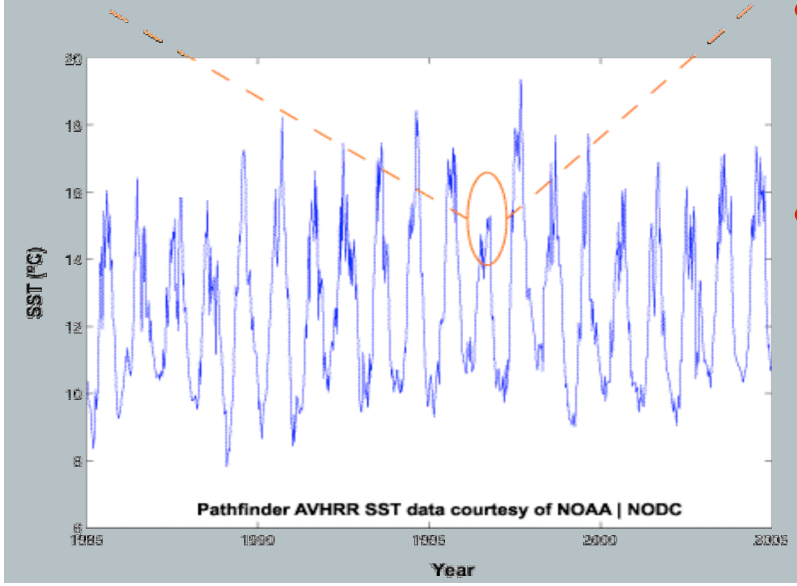
More Ice = Less whales counted
(more ice habitat for whales to hide in)



Work in progress by Brownell & Wilson, NOAA/NMFS/SWFSC ERD

Ground Truth for Stock Assessments





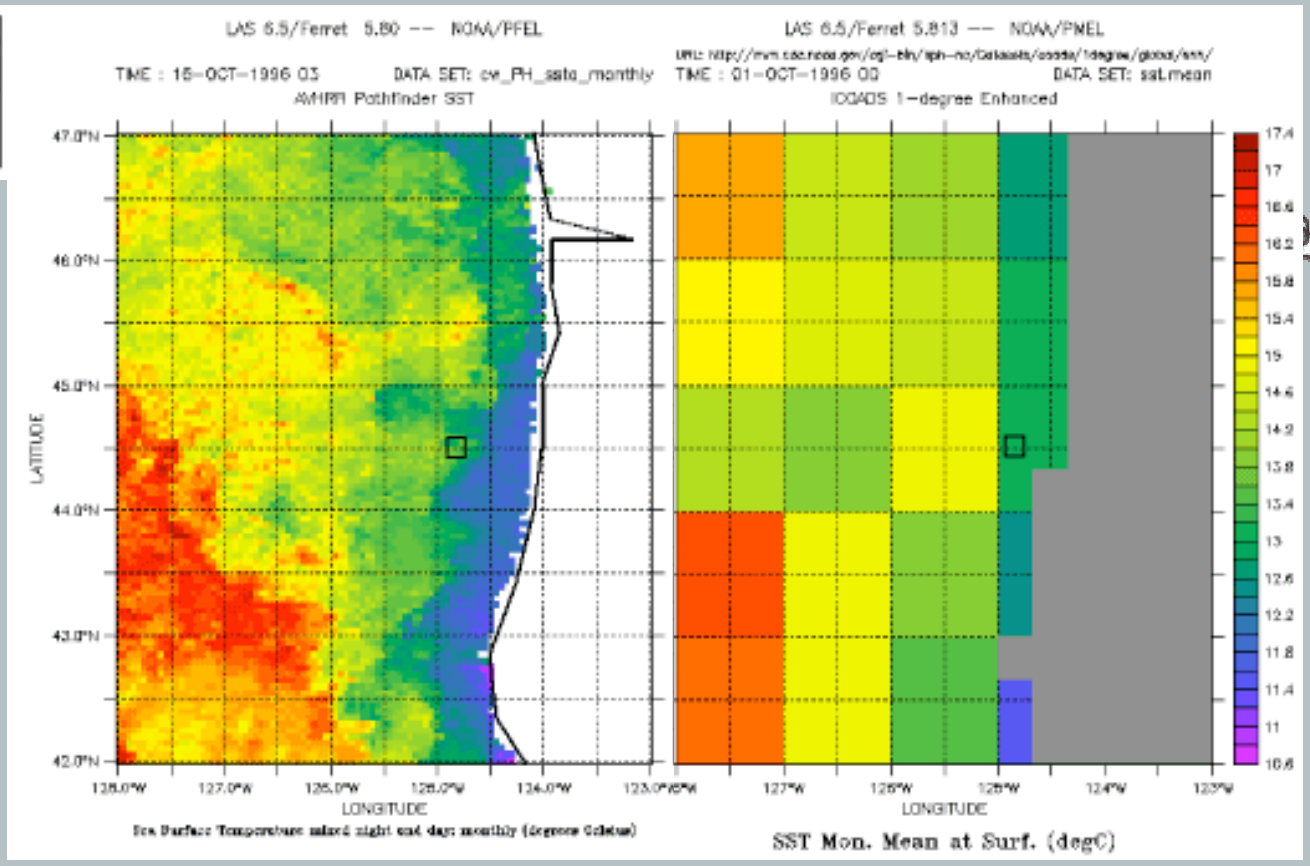
Sablefish

(*Anopoploma fimbria*)

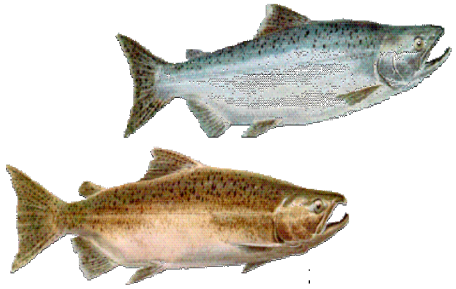
- **Pathfinder's long time series allowed us to show that the SST > 15°C for a period when tagged sablefish were known to survive.**
- **This contradicted laboratory studies of tag-related mortality used in stock assessments.**
- **The end result will be an increase in the catch quota reflecting a more realistic stock assessment.**

S. Berkeley, UC – Santa Cruz

Ground Truth for Stock Assessments

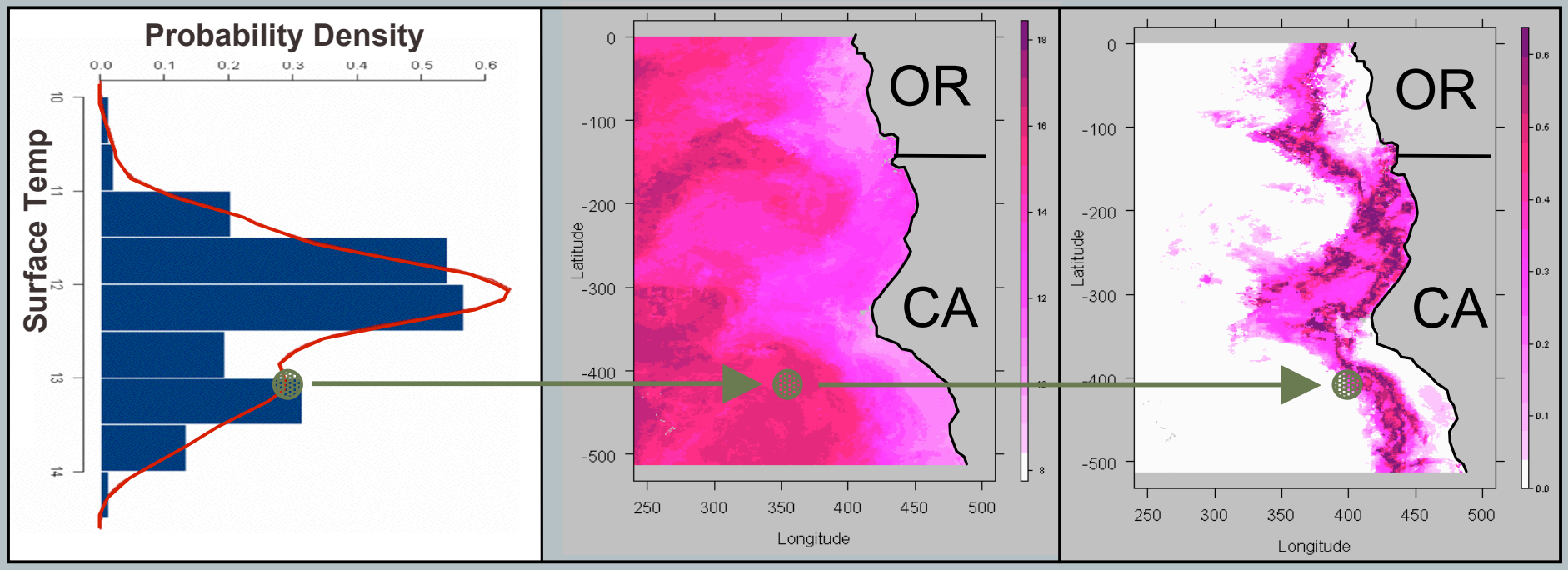


- Version 5 Pathfinder resolves off-shore water from coastal upwelling
- 1° COADS data cannot do this.



Chinook Potential Habitat

(Oncorhynchus tshawytscha)



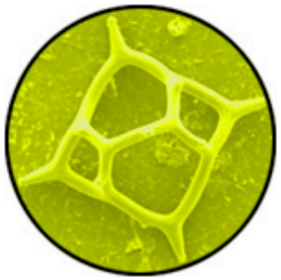
Density of fish's surface temperature experience from tag data

Satellite SST

"Contours of utilization" – likely fish location

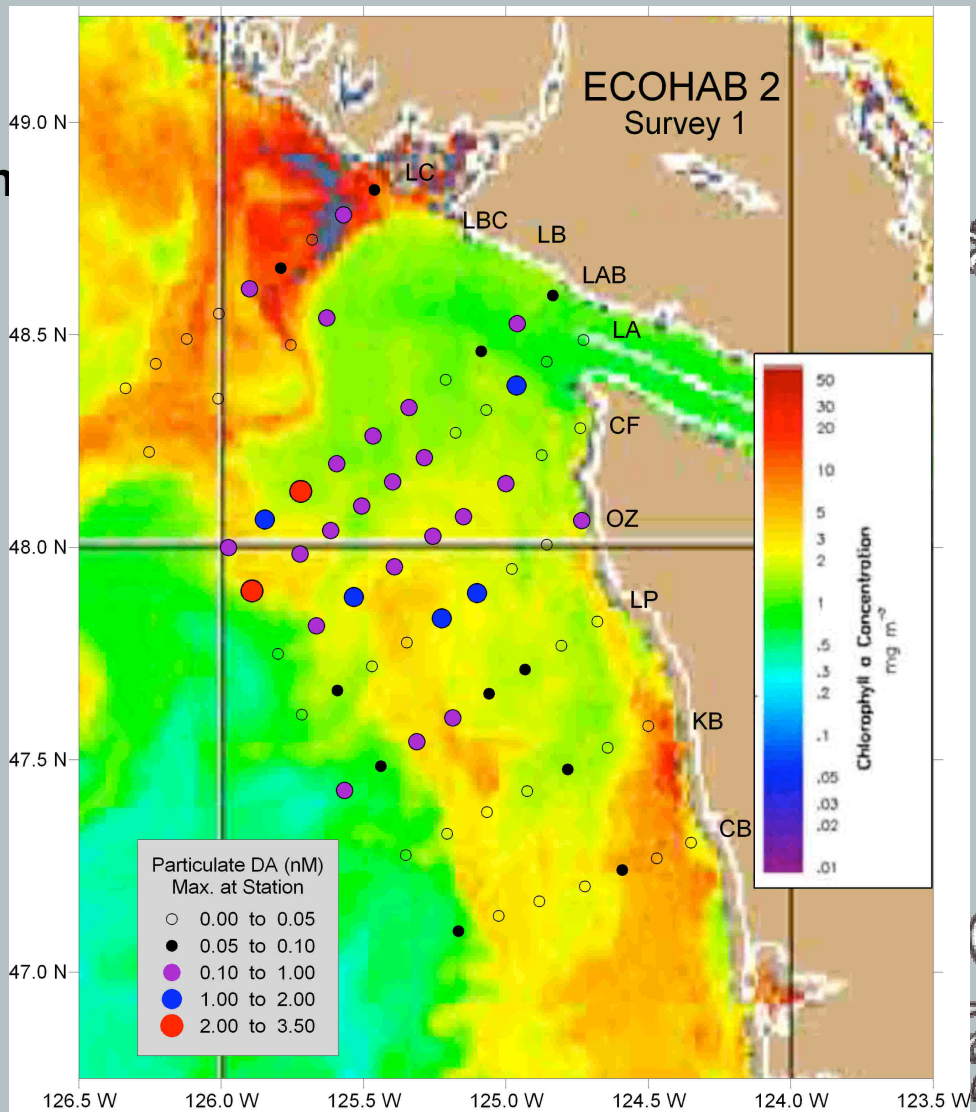
Hinke, Watters et al., MEPS, 2005 *NOAA/NMFS/SWFSC*

Cruise Support

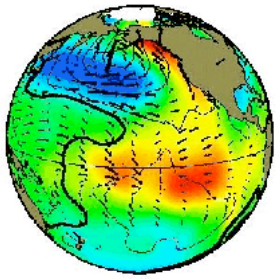


Domoic Acid levels (circles) measured during an ECOHAB survey, overlaid on top of satellite chlorophyll.

Satellite chlorophyll data is crucial for monitoring development of harmful algal blooms (HABs).

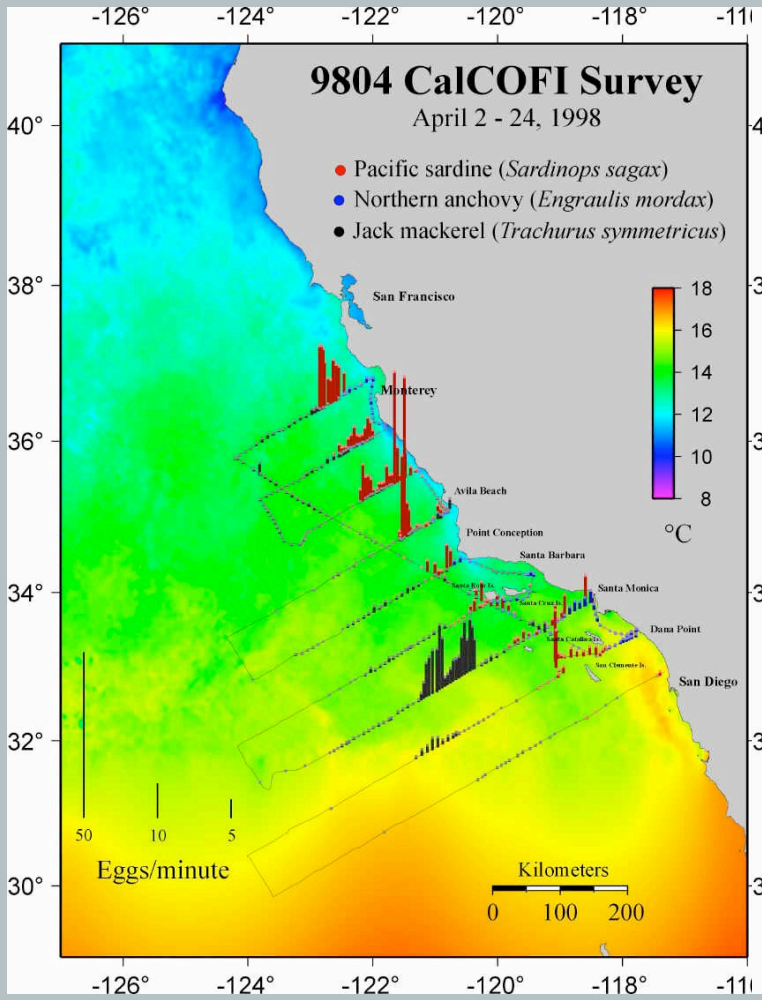


From Vera Trainer
NOAA/NMFS/NWFSC

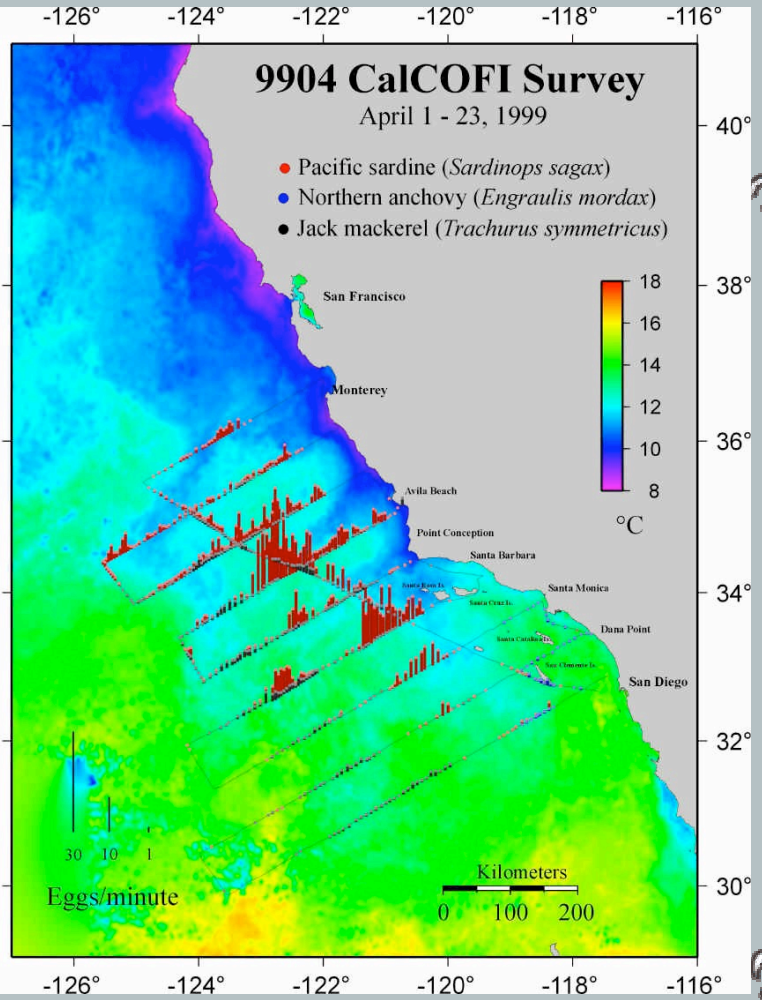


Interannual Variability

El Niño



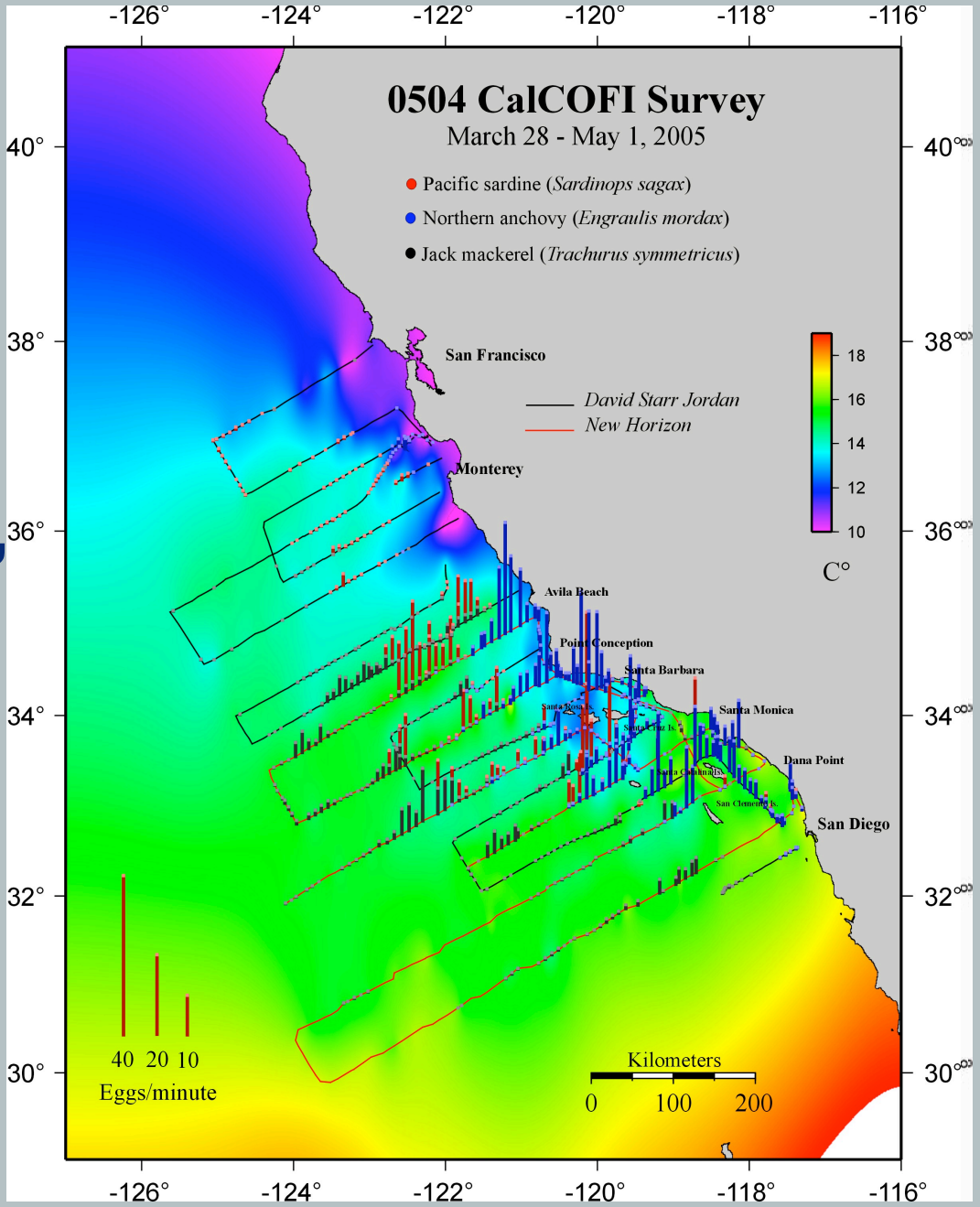
La Niña



Courtesy of Rich Charter, NOAA/NMFS/SWFSC

April CalCOFI egg surveys, 1997-2005

Courtesy of Rich Charter, NOAA/NMFS/SWFSC



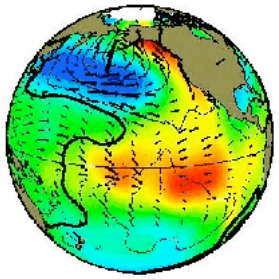
http://swfsc.nmfs.noaa.gov/frd/CalCOFI/CurrentCruise/sardmaps.htm

Question…

The high temporal and spatial resolution of satellite data, and its continuity, make satellite data an important tool for monitoring and characterizing marine ecosystems.

Yet, the full potential of satellite data has not been realized within NMFS, or within fisheries science more generally.

Why is satellite data underutilized within NMFS, and what can be done to take advantage of the wealth of information this data can provide?



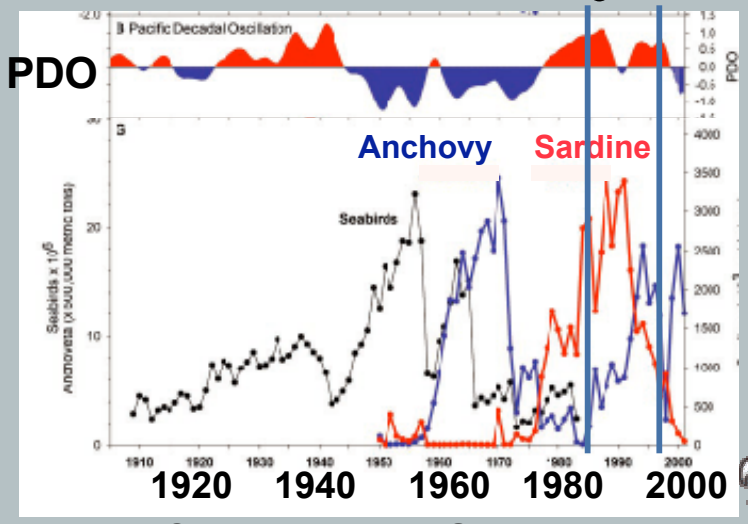
Length of Time Series

- **Compared to many fisheries datasets the time series of satellite data are relatively short:**

Sea Ice	**1979→**	
SST:	**1985→**	**[2005?]**
SSH:	**1993→**	
Chlorophyll:	**1997→**	
Wind:	**1999→**	

Pathfinder project has lost its funding in 2006….

- **It's essential that climate quality records of satellite data be maintained!**
- **This point needs to be emphasized as NOAA takes over operation of a number of satellite measurements (i.e. ocean color and SSH).**



From Chavez et al. [Science, 2003]

Data Access Issues

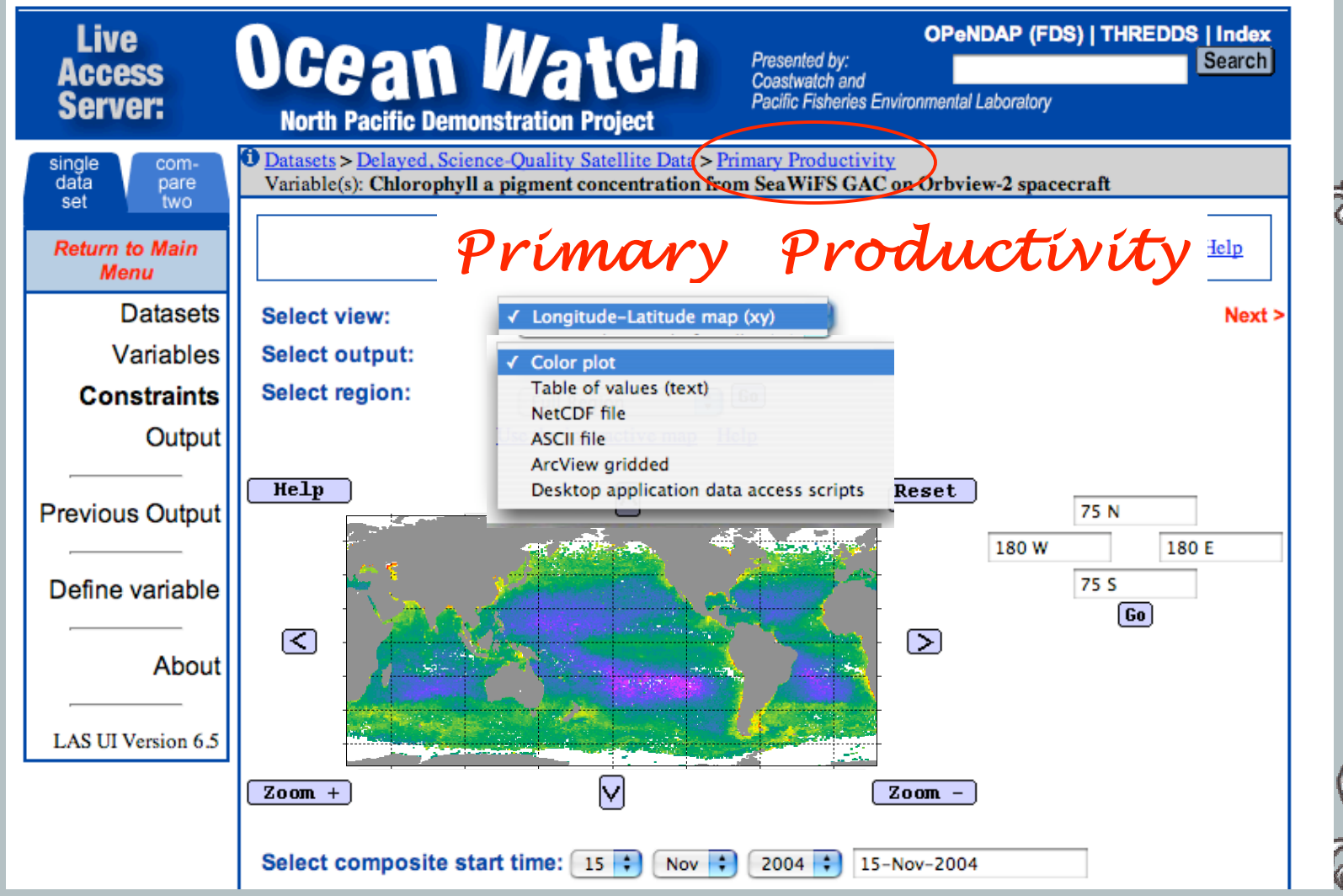
It can be difficult to access and manipulate the large depository of existing satellite data. Efforts are underway to address this:

- **New live access server (LAS) and browser at the west coast CoastWatch Node provide access to multiple satellite datasets, in a variety of formats, including IOOS-compatible OPeNDAP technology.**
- **Four NMFS scholarships given this year to attend a 2-week satellite course in June at Cornell University.**
- **A 3-day course for NMFS and NOS participants on accessing and using satellite data is being planned for Aug. 22-24 at OSU in Corvallis, OR.**

These activities made possible by funding by NOAA's R&O project

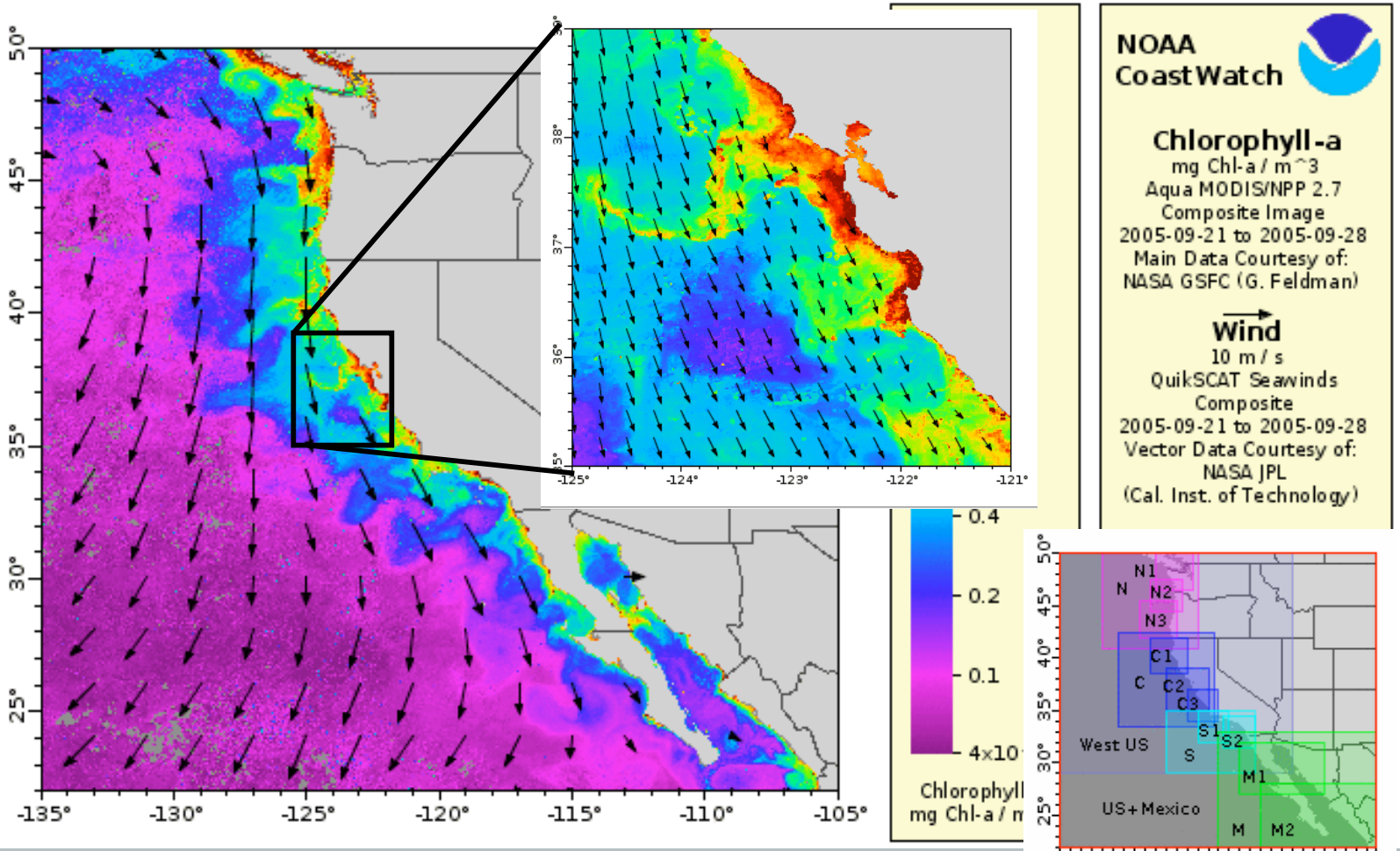
SWFSC OceanWatch LAS at ERD

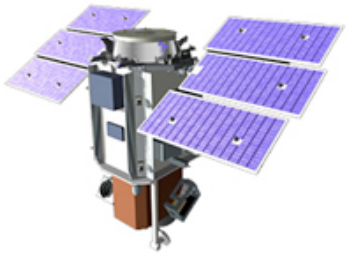
http://oceanwatch.pfeg.noaa.gov



New CoastWatch Browser

http://coastwatch.pfel.noaa.gov/coastwatch/CWBrowser.jsp



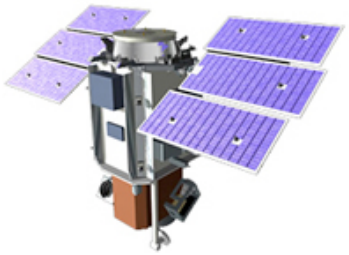


Satellite Data Training Course

- 3-day course for NMFS and NOS participants who are interested in using satellite data
- Aug 22-24, 2006 at OSU/CIOSS in Corvallis, OR
- Funds available from NOAA's Satellite Transition R&O (Research and Operations) project to cover participants' travel costs

For more information contact Cara Wilson

cara.wilson@noaa.gov



NASA/NOAA Joint Workshop

- NASA/NOAA Joint workshop on integrating satellite data and modeling data into ecosystem-based management within NMFS.
- May 3-5, 2006 at MBARI near Monterey, CA.
- Funds from NOAA's Satellite Transition R&O (Research and Operations) project to cover NOAA participants' travel costs.